Contract Number DACA42-03-C-0024

LOGANEnergy Corp.

Initial Project Report
For
PEM Fuel Cell Demonstration, US Naval Air Depot, Cherry Point, North Carolina

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY02

US Naval Air Depot
Bldg 154AE
MCAS Cherry Point, NC
4/26/04

Executive Summary

LOGANEnergy is in the process of installing one Plug Power GenSys5P 5kW PEM fuel cell power plant at Building 154AE belonging to the Naval Air Depot at MCAS Cherry Point, NC. The unit will be fueled by LP Gas and installed to operate in both grid parallel and grid independent configurations. Local subcontractors will be hired to assist with the electrical, mechanical, and thermal recovery installation tasks. It is anticipated that the host site will experience a net annual energy cost increase of approximately $1,600 over the cost of displaced utility power. This is due to the relatively low operating efficiency of the Plug propane unit (20%), and the comparative high cost of LP Gas. The host site project engineer is Bill Livingston, whose contact information appears below.

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

US Naval Air Depot Building 154AE PEM Demonstration Project, MCAS, Cherry Point, NC

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

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Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

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Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
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6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022
Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Contract: Four year PC25 PM Services Maintenance Agreement.
In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant installed at NAS Patuxent River, MD.
Contract # Plug Power 100303, 01/2004 to 12/2004

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, VA and operate in standard gird connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set a new level of performance expectations for this product, and are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5 year service and maintenance agreement
Mr. Ron Allison
A Partners LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a multi unit load sharing electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package installed in the project includes a 100-ton chiller that captures 210 degree F thermal energy supplied by the three fuel cells to cool the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months. Contract # A Partners LLC, 12/31/01

7.0 Host Facility Information

The Naval Air Depot (NADEP) located at MCAS Cherry Point, NC provides extensive maintenance and engineering support to Navy and Marine Corps aviation, as well as other armed services, federal agencies and foreign governments.

8.0 Fuel Cell Site Information

Since October 2003, LOGAN has worked closely with NADEP, fuel cell project engineers, Bob King and Bill Livingston, to site one Plug Power 5kW fuel cell at one of its maintenance facilities. After considering several alternatives NAVDEP chose Building 154AE to be the host site for the project. All of the installation tasks required to install the unit were discussed during extensive briefings with NAVDEP over several weeks in November 2003 and January 2004. Additionally LOGAN personnel performed two site visits prior to scheduling the kick-off meeting to insure that all major installation issues were covered. However, at the meeting, LOGAN learned for the first time that siting a 500-gallon LP Gas storage tank at Building 154AE would require special security considerations. A representative from base security stated that the 500-gallon LPG tank proposed for the project would have to sit within a security fence enclosing a 25-foot open radius around the tank. This revelation led to an extensive site reevaluation to determine how and where to install the fuel cell and LPG tank at the maintenance facility given the site restrictions seen in the photo below.

In order to keep to the original plan and meet the new security constraints, it was determined that the LPG tank would need to be sized down to 150 gallons to mitigate the requirements for the enlarged security area required for the 500 gallon tank preferred for the project. However, this solution will impose an additional logistical burden for the host because the tank will need filling each week to insure that it is maintained at a minimum safe fill level.

The fuel cell will be connected to the facility in a grid parallel/grid independent configuration, feeding a 60-amp breaker in the existing main service panel and three 15-amp circuit breakers in the emergency panel to be added by LOGAN. The unit will operate normally at 2.5 kW, consuming approximately 12 gallons LPG per day. A 20,000 Btu fan coil unit that will provide space heating on the shop floor during the winter months will capture fuel cell waste heat. A photo of the unit appears below in the thermal recovery section. A simple one-line drawing of the installation appears in the appendix below. A site map also attached in the appendix section indicates Building 154AE location on the air station.

9.0 Electrical System

The one-line drawing in the appendix section should be referenced for the discussion in this section.

The Plug Power 5kW GenSys5P has a maximum output of 4.5 kW at 120 volts ac, 60 Hz. Under normal operating conditions the unit will provide 2.5 kW service to the maintenance facility's main service panel seen at right. In addition LOGAN will install an emergency service panel to the left of the main panel and transfer up to 30 amps of load to simulate critical circuit support during the demonstration period. Even so, the emergency load panel will be wired to the grid independent bus in the fuel cell and will provide power to the panel in the event of a utility failure. The panel is located on the east wall of the maintenance facility approximately 200 feet from the fuel cell.

10.0 Thermal Recovery System

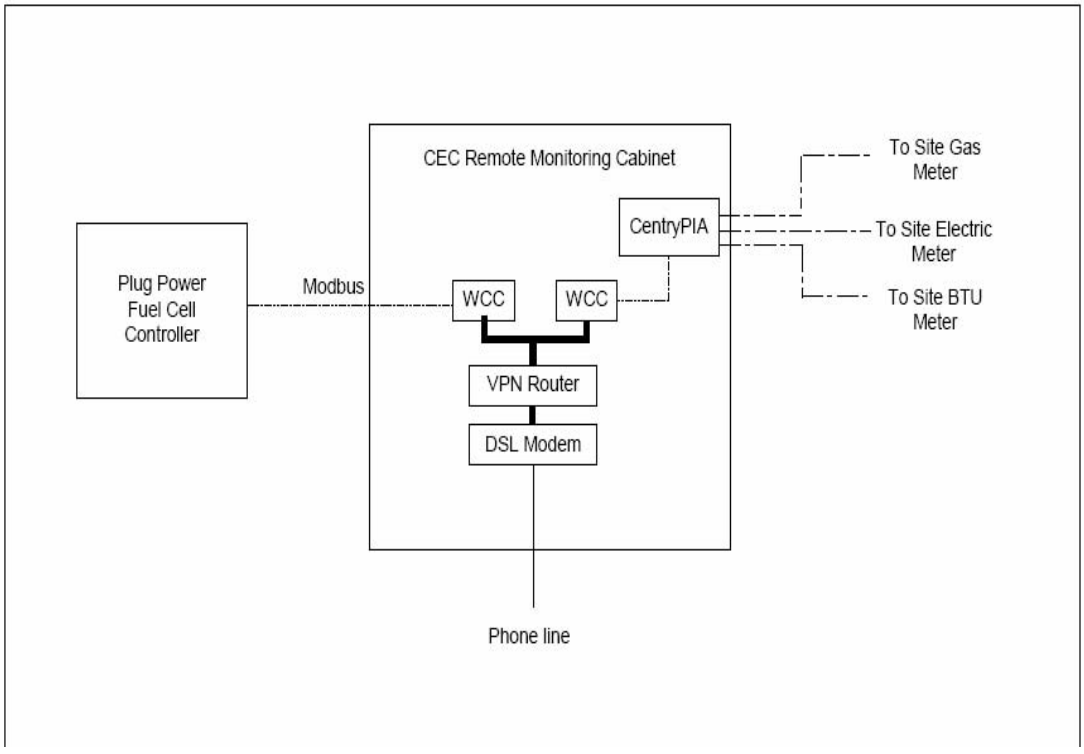
The one-line drawing in the appendix section should be referenced for the discussion in this section.

The GenSys5P delivers approximately 20,000Btu/h to the customer heat exchanger at the 2.5kW power set point, which will be maintained during the course of the test period. In order to demonstrate this capability, LOGAN plans to install a Modine HD47L or similar fan coil unit in the maintenance building. A picture of the Modine 22,000 Btu fan coil unit can be seen below at left. The unit will be suspended from the maintenance building's ceiling; also seen below in the photo at right. The unit will be plumbed into the fuel cell's heat exchanger that will supply 20,000 Btu/h at 60 degrees C with a flow rate of 2.5gpm. The Modine HC 47L unit, pictured below, will provide a warm air output of 35 degrees C at 860 cfm.

11.0 Data Acquisition System

The one-line drawing in the appendix section should be referenced for the discussion in this section.

Following is the drawing of Connected Energy equipment necessary to commission Plug Power fuel cell genset sites in order to communicate with a remote and central data center securely via the Internet. One CENTRYWCC communicates with the Plug Power controller, and another CENTRYWCC is dedicated to interface with the site meters and sensors via CENTRYPIA. The CENTRYPIA allows communication with multiple pulse or analog inputs. The VPN router at the site encrypts the traffic between the site and the data center to make a very secure connection, similar to what banks use to send financial information over the Internet. The modem is optional. If the site allows for direct network access, no modem is necessary (see cost reduction discussion following). Other modems can be used at sites where access or cost drives alternative communication strategies to DSL.



The WCC Router system described above will be connected to the Internet via a commercial DSL line hosted by a local ISP. The system will be monitored daily by LOGAN to evaluate the site's operating status and to analyze certain parameters that reveal the health of the unit. In addition the unit will send out email alerts whenever a forced outage occurs. The site may be

viewed by browsing to https://www.enerview.com/EnerView/login.asp then entering *logan.user* in to the user window, and entering *guest* in the password window.

12.0 Economic Analysis

Naval Air Depot, MCAS Cherry Point, NC

Estimated Project Utility Rates					
1) Water (per 1,000 gallons)			$2.10		
2) Utility (per KWH)			$ 0.06		
3) LP Gas (per gallon)			$ 1.01		
Estimated First Cost					
Plug Power 5 kW GenSys5C				$ 75,000.00	
Shipping				$ 2,800.00	
Installation electrical				$ 2,275.00	
Installation mechanical & thermal				$ 2,250.00	
Watt Meter, Instrumentation, Web Package				$ 9,650.00	
Site Prep, labor materials				$ 925.00	
Technical Supervision/Start-up				$ 4,500.00	
Total				$ 97,400.00	
Assume Five Year Simple Payback					$ 19,480.00
Forcast Operating Expenses	Volume		$/Hr	$/ Yr	
LP Gas @ 2.5kW	0.53	$	0.54	$ 4,221.77	
Water Gallons per Year	14,016			$ 29.43	
Total Annual Operating Cost					$ 4,251.20
Economic Summary					
Forcast Annual kWH			19710		
Annual Cost of Operating Power Plant		$	0.216	kWH	
Credit Annual Thermal Recovery		$	(0.011)	kWH	
Project Net Operating Cost		$	0.205	kWH	
Displaced Utility cost		$	0.06	kWH	
Energy Savings		$	(0.143)	kWH	

Explanation of Calculations:

Estimated First Cost Total is a *sum* of all the listed first cost components.
Assumed Five Year Simple Payback is the Estimated First Cost Total *divided by* 5 years.
Forecast Operating Expenses:

LP gas usage in a fuel cell system set at 2.5 kW will consume 0.53 gallons per hour. The cost per hour is 0.53 gph *x* the cost of LP gas to MCAS Cherry Point per gallon at $1.01. The cost per year at $4221.77 is the cost per hour at $0.54 *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

LP gas fuel cell systems set at 2.5 kW will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed at 14,016 gallons per year is 1.6 gph *x* 8760 hours per year. The cost per year at $29.43 is 14,016 gph *x* cost of water to MCAS Cherry Point at $2.10 per 1000 gallons.

The Total Annual Operating Cost, $4251.20 is the *sum of* the cost per year for the LP gas and the cost per year for the water consumption.

Economic Summary:

The Forecast Annual kWh at 19,710 kWh is the product of 2.5 kW set-point for the fuel cell system *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

The Annual Cost of Operating the Power Plant at $0.216 per kWH is the Total Operating Cost at $4251.20 *divided by* the forecast annual kWh at 19,710 kWh.

The Credit Annual Thermal Recovery at -$0.011 is 22,000 BTU per hour of thermal recovery capacity by the fuel cell set at 2.5 kW *x* 3650 hours from five months of winter operation *x* a load factor of 0.25 *divided by* 92,000 BTU per gallon provided by the gas. This equals 218.21 gallons of LP gas. *Multiply* this number by the cost of LP gas at $1.01, and *divide* that product by the total kWh of 19,710. As a credit to the cost summary, the value is expressed as a negative number.

The Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery.

The Displaced Utility Cost is the cost of electricity to MCAS per kWh.

Energy Savings equals the Displaced Utility Cost *minus* the Project Net Operating Cost.

13.0 Kickoff Meeting Information

The NAVDEP kick-off meeting took place at NADEP Headquarters at MCAS Cherry Point, NC on Tuesday, February 24, 2004. The attendees appear in the following list.

NADEP/CPMCAS PEM Demonstration Kick Off Meeting

24-Feb-04

1 David Knapp
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2 Tarry Bachmann
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The meeting covered the objectives of the DOD PEM demonstration program and offered the attendees the opportunity to ask questions and provide input to the conduct of the project. Following the meeting, representatives of CERL/LOGAN (seen in the photo at right below), and NADEP personnel toured the proposed installation site. Because of the new constraints imposed by MCAS security officials, the meeting concluded without knowing precisely where the fuel cell pad and LPG tank would be sited. Thanks to the efforts of Bill Livingston, the outstanding issues were resolved in early April. At this point the project is moving forward and will follow the time line in paragraph 14 below.

14.0 Status/Timeline

8/26/03	Award Contract
2/24/04	Kickoff Meeting
5/20/04	Initial Report Due
6/15/04	Installation Complete and Start of Demonstration
8/15/04	Midterm Report Due
6/14/05	Shutdown- End of Demonstration
8/15/04	Final Report Due

Appendix (1): Installation one-line drawing.